MMBT2222LT1, MMBT2222ALT1

MMBT2222ALT1 is a Preferred Device

General Purpose Transistors

NPN Silicon

Features

- Pb-Free Packages are Available

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage MMBT2222LT1 MMBT2222ALT1	V_{CEO}	 30 40	Vdc
Collector-Base Voltage MMBT2222LT1 MMBT2222ALT1	V_{CBO}	 60 75	Vdc
Emitter-Base Voltage MMBT2222LT1 MMBT2222ALT1	V_{EBO}	 5.0 6.0	Vdc
Collector Current - Continuous	I_C	600	mAdc
Collector Current - Peak (Note 3)	I_{CM}	1100	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board (Note 1) $T_A = 25°C$ Derate above 25°C	P_D	 225 1.8	 mW mW/°C
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	556	°C/W
Total Device Dissipation Alumina Substrate (Note 2) $T_A = 25°C$ Derate above 25°C	P_D	 300 2.4	 mW mW/°C
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	417	°C/W
Junction and Storage Temperature Range	T_J, T_{stg}	-55 to +150	°C

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

1. FR-5 = 1.0 × 0.75 × 0.062 in.
2. Alumina = 0.4 × 0.3 × 0.024 in. 99.5% alumina.
3. Reference SOA curve.

ON Semiconductor®

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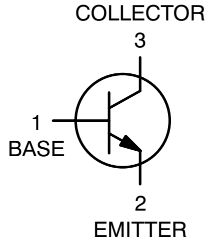
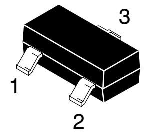
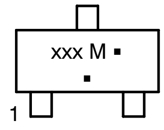




SOT-23
CASE 318
STYLE 6

MARKING DIAGRAM



xxx = 1P or M1B
M = Date Code*
▪ = Pb-Free Package

(Note: Microdot may be in either location)

*Date Code orientation and/or overbar may vary depending upon manufacturing location.

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 6 of this data sheet.

Preferred devices are recommended choices for future use and best overall value.

July, 2007 - Rev. 7

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

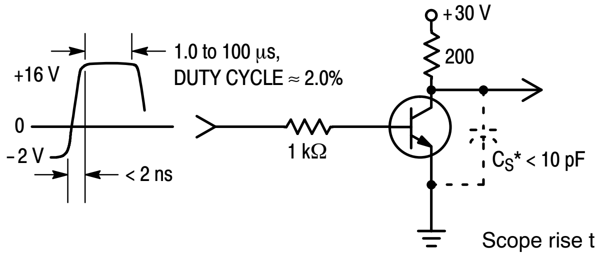
Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector–Emitter Breakdown Voltage (I_C = 10 mAdc, I_B = 0) MMBT2222	$V_{(BR)CEO}$	30	–	Vdc
MMBT2222A		40	–	
Collector–Base Breakdown Voltage (I_C = 10 μAdc, I_E = 0) MMBT2222	$V_{(BR)CBO}$	60	–	Vdc
MMBT2222A		75	–	
Emitter–Base Breakdown Voltage (I_E = 10 μAdc, I_C = 0) MMBT2222	$V_{(BR)EBO}$	5.0	–	Vdc
MMBT2222A		6.0	–	
Collector Cutoff Current (V_{CE} = 60 Vdc, $V_{EB(off)}$ = 3.0 Vdc) MMBT2222A	I_{CEX}	–	10	nAdc
Collector Cutoff Current (V_{CB} = 50 Vdc, I_E = 0) MMBT2222	I_{CBO}	–	0.01	μAdc
(V_{CB} = 60 Vdc, I_E = 0) MMBT2222A		–	0.01	
(V_{CB} = 50 Vdc, I_E = 0, T_A = 125°C) MMBT2222		–	10	
(V_{CB} = 60 Vdc, I_E = 0, T_A = 125°C) MMBT2222A		–	10	
Emitter Cutoff Current (V_{EB} = 3.0 Vdc, I_C = 0) MMBT2222A	I_{EBO}	–	100	nAdc
Base Cutoff Current (V_{CE} = 60 Vdc, $V_{EB(off)}$ = 3.0 Vdc) MMBT2222A	I_{BL}	–	20	nAdc
ON CHARACTERISTICS				
DC Current Gain	h_{FE}			–
(I_C = 0.1 mAdc, V_{CE} = 10 Vdc)		35	–	
(I_C = 1.0 mAdc, V_{CE} = 10 Vdc)		50	–	
(I_C = 10 mAdc, V_{CE} = 10 Vdc)		75	–	
(I_C = 10 mAdc, V_{CE} = 10 Vdc, T_A = −55°C) MMBT2222A only		35	–	
(I_C = 150 mAdc, V_{CE} = 10 Vdc) (Note 4)		100	300	
(I_C = 150 mAdc, V_{CE} = 1.0 Vdc) (Note 4)		50	–	
(I_C = 500 mAdc, V_{CE} = 10 Vdc) (Note 4) MMBT2222		30	–	
MMBT2222A		40	–	
Collector–Emitter Saturation Voltage (Note 4)	$V_{CE(sat)}$			Vdc
(I_C = 150 mAdc, I_B = 15 mAdc) MMBT2222		–	0.4	
MMBT2222A		–	0.3	
(I_C = 500 mAdc, I_B = 50 mAdc) MMBT2222		–	1.6	
MMBT2222A		–	1.0	
Base–Emitter Saturation Voltage (Note 4)	$V_{BE(sat)}$			Vdc
(I_C = 150 mAdc, I_B = 15 mAdc) MMBT2222		–	1.3	
MMBT2222A		0.6	1.2	
(I_C = 500 mAdc, I_B = 50 mAdc) MMBT2222		–	2.6	
MMBT2222A		–	2.0	
SMALL–SIGNAL CHARACTERISTICS				
Current–Gain – Bandwidth Product (Note 5)	f_T			MHz
(I_C = 20 mAdc, V_{CE} = 20 Vdc, f = 100 MHz) MMBT2222		250	–	
MMBT2222A		300	–	
Output Capacitance	C_{obo}			pF
(V_{CB} = 10 Vdc, I_E = 0, f = 1.0 MHz)		–	8.0	
Input Capacitance	C_{ibo}			pF
(V_{EB} = 0.5 Vdc, I_C = 0, f = 1.0 MHz) MMBT2222		–	30	
MMBT2222A		–	25	
Input Impedance	h_{ie}			kΩ
(I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz) MMBT2222A		2.0	8.0	
(I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz) MMBT2222A		0.25	1.25	
Voltage Feedback Ratio	h_{re}			X 10^{-4}
(I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz) MMBT2222A		–	8.0	
(I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz) MMBT2222A		–	4.0	
Small–Signal Current Gain	h_{fe}			–
(I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz) MMBT2222A		50	300	
(I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz) MMBT2222A		75	375	
Output Admittance	h_{oe}			μmhos
(I_C = 1.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz) MMBT2222A		5.0	35	
(I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz) MMBT2222A		25	200	

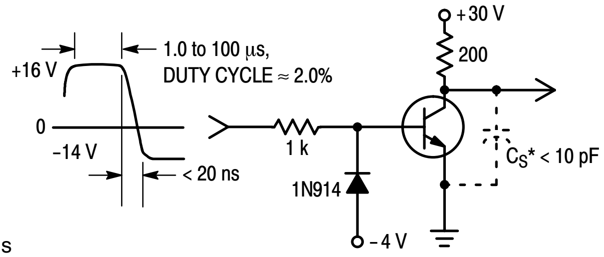
ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

Characteristic		Symbol	Min	Max	Unit
SMALL−SIGNAL CHARACTERISTICS					
Collector Base Time Constant (I_E = 20 mAdc, V_{CB} = 20 Vdc, f = 31.8 MHz)	MMBT2222A	rb, C_c	–	150	ps
Noise Figure (I_C = 100 μAdc, V_{CE} = 10 Vdc, R_S = 1.0 kΩ, f = 1.0 kHz)	MMBT2222A	NF	–	4.0	dB
SWITCHING CHARACTERISTICS (MMBT2222A only)					
Delay Time	(V_{CC} = 30 Vdc, $V_{BE(off)}$ = −0.5 Vdc, I_C = 150 mAdc, I_{B1} = 15 mAdc)	t_d	–	10	ns
Rise Time		t_r	–	25	
Storage Time	(V_{CC} = 30 Vdc, I_C = 150 mAdc, I_{B1} = I_{B2} = 15 mAdc)	t_s	–	225	ns
Fall Time		t_f	–	60	

4. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.
5. f_T is defined as the frequency at which $|h_{fe}|$ extrapolates to unity.

SWITCHING TIME EQUIVALENT TEST CIRCUITS





Scope rise time < 4 ns
*Total shunt capacitance of test jig, connectors, and oscilloscope.

Figure 1. Turn−On Time

Figure 2. Turn−Off Time

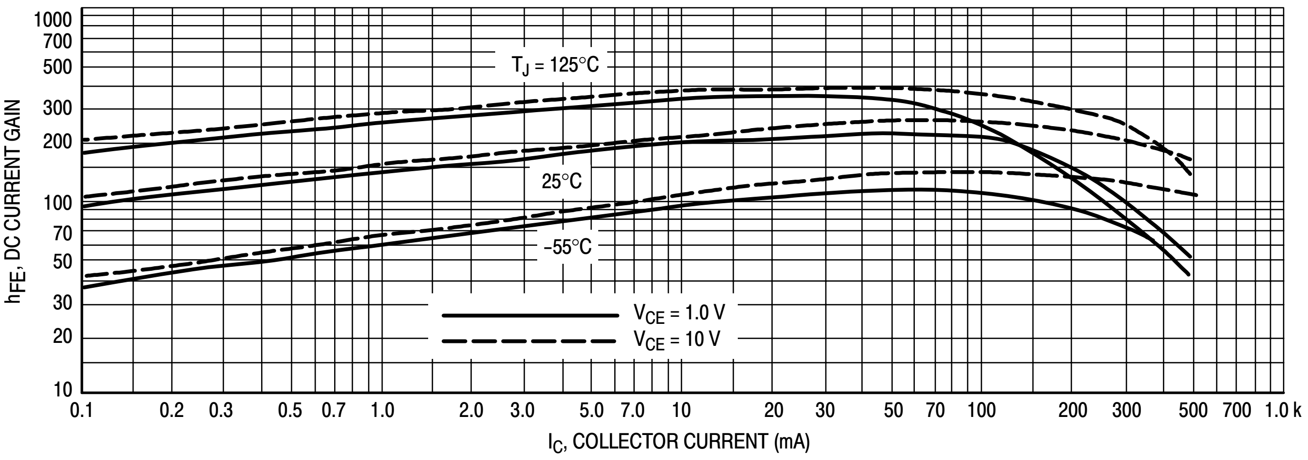


Figure 3. DC Current Gain

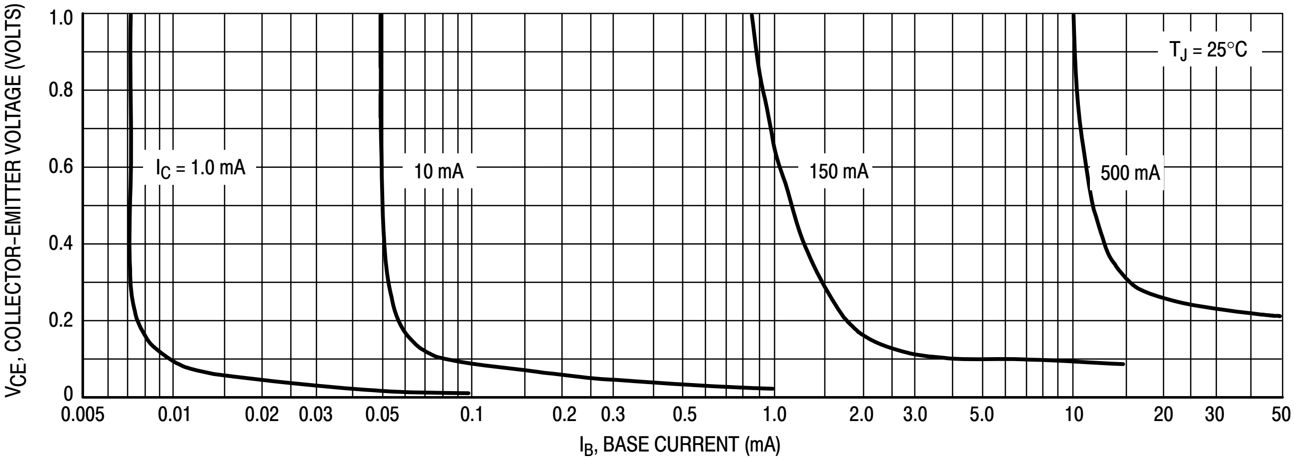


Figure 4. Collector Saturation Region

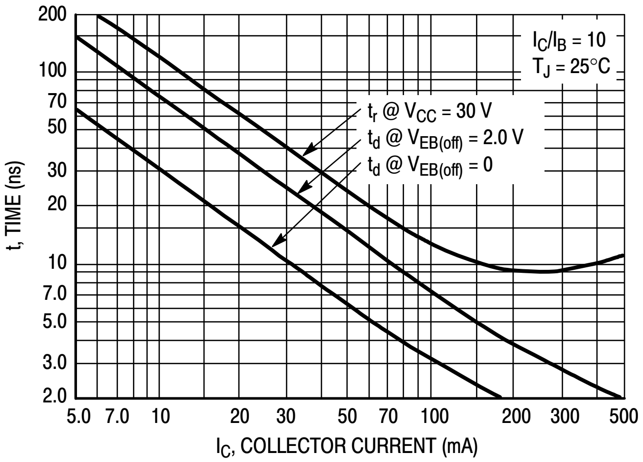


Figure 5. Turn-On Time

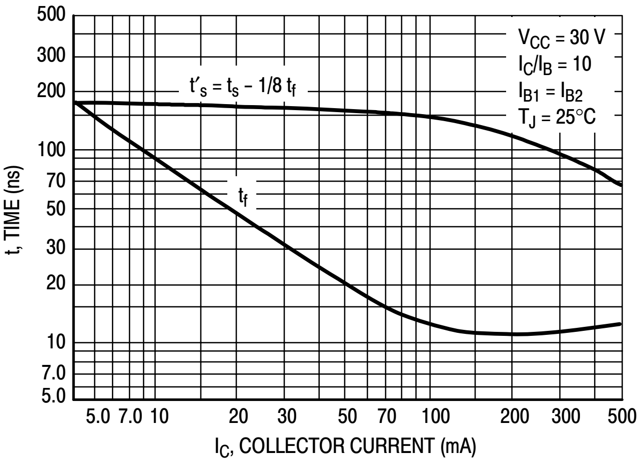


Figure 6. Turn-Off Time

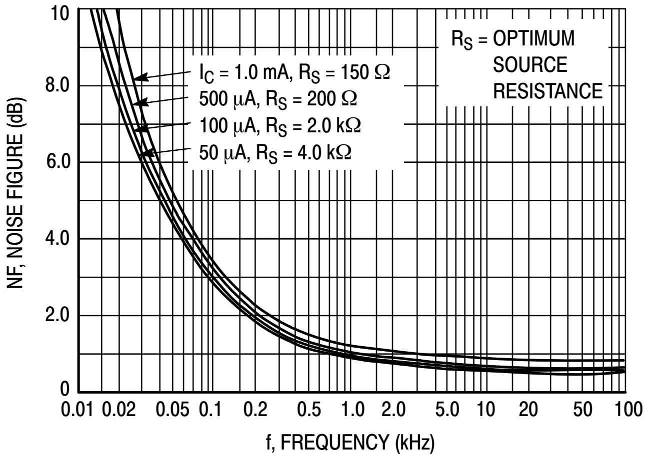


Figure 7. Frequency Effects

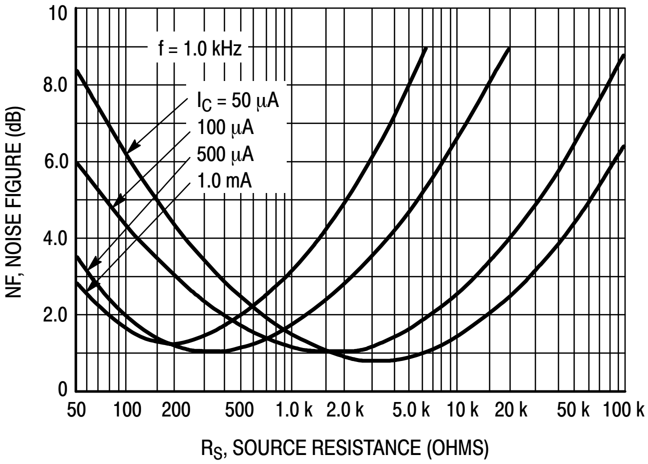


Figure 8. Source Resistance Effects

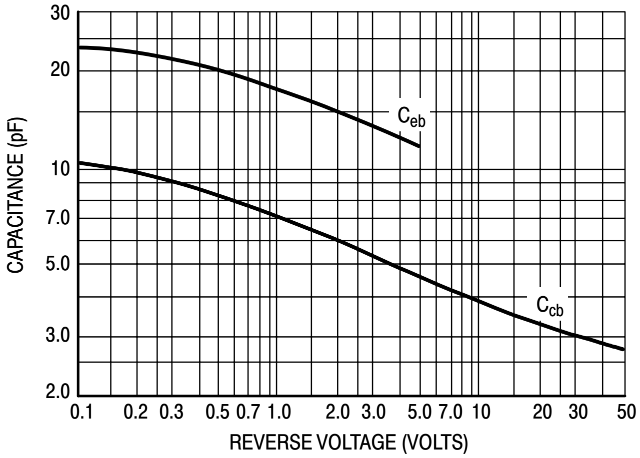


Figure 9. Capacitances

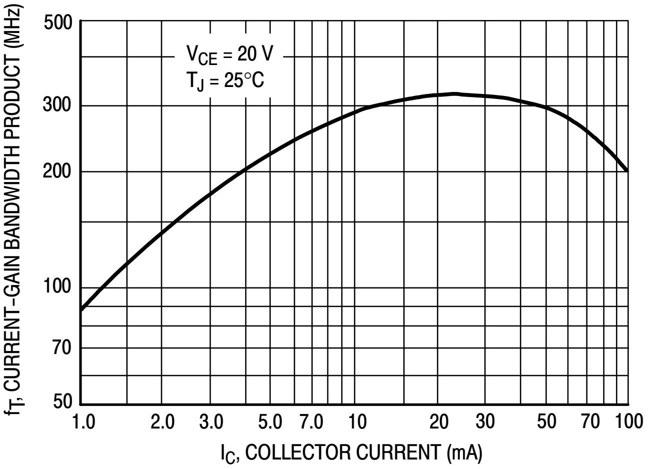


Figure 10. Current-Gain Bandwidth Product

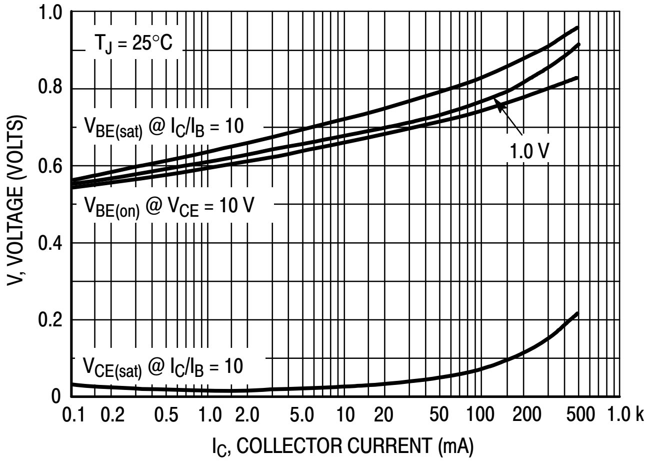


Figure 11. “On” Voltages

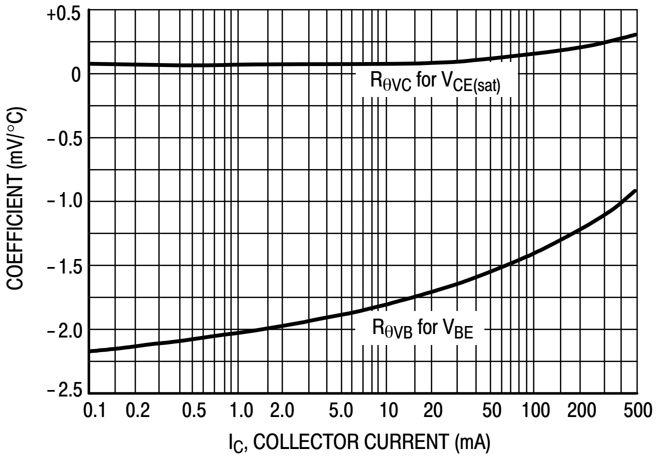


Figure 12. Temperature Coefficients

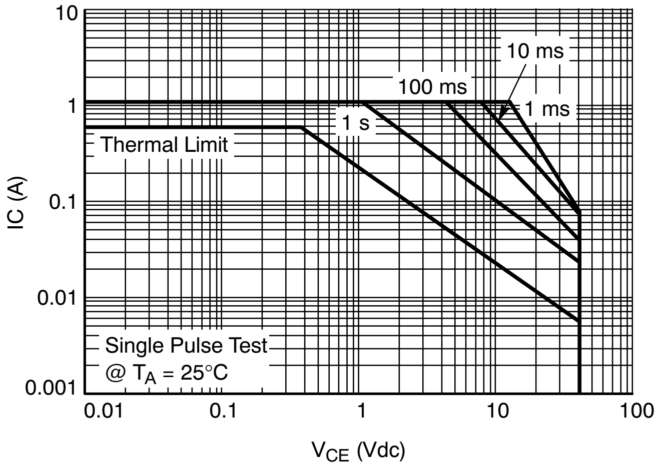


Figure 13. Safe Operating Area

ORDERING INFORMATION

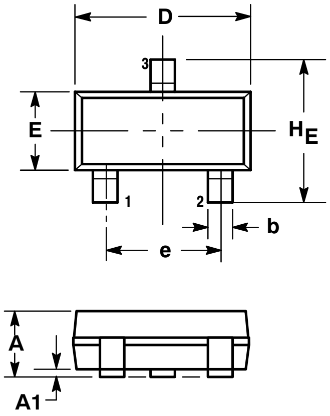
Device	Specific Marking Code	Package	Shipping†
MMBT2222LT1	M1B	SOT−23	3000 / Tape & Reel
MMBT2222LT1G	M1B	SOT−23 (Pb−Free)	3000 / Tape & Reel
MMBT2222ALT1	1P	SOT−23	3000 / Tape & Reel
MMBT2222ALT1G	1P	SOT−23 (Pb−Free)	3000 / Tape & Reel
MMBT2222LT3	M1B	SOT−23	10,000 / Tape & Reel
MMBT2222LT3G	M1B	SOT−23 (Pb−Free)	10,000 / Tape & Reel
MMBT2222ALT3	1P	SOT−23	10,000 / Tape & Reel
MMBT2222ALT3G	1P	SOT−23 (Pb−Free)	10,000 / Tape & Reel

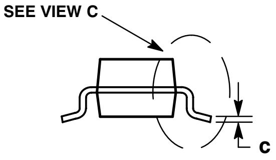
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

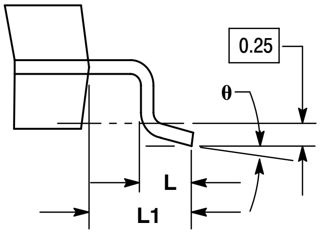
PACKAGE DIMENSIONS

SOT−23 (TO−236)

CASE 318−08
ISSUE AN







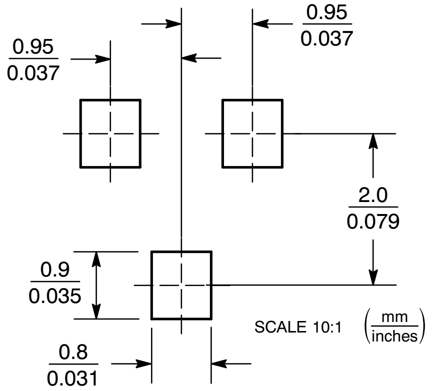
VIEW C

NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. 318−01 THRU −07 AND −09 OBSOLETE, NEW STANDARD 318−08.

	MILLIMETERS			INCHES		
DIM	**MIN**	**NOM**	**MAX**	**MIN**	**NOM**	**MAX**
A	0.89	1.00	1.11	0.035	0.040	0.044
A1	0.01	0.06	0.10	0.001	0.002	0.004
b	0.37	0.44	0.50	0.015	0.018	0.020
c	0.09	0.13	0.18	0.003	0.005	0.007
D	2.80	2.90	3.04	0.110	0.114	0.120
E	1.20	1.30	1.40	0.047	0.051	0.055
e	1.78	1.90	2.04	0.070	0.075	0.081
L	0.10	0.20	0.30	0.004	0.008	0.012
L1	0.35	0.54	0.69	0.014	0.021	0.029
H_E	2.10	2.40	2.64	0.083	0.094	0.104

STYLE 6:
PIN 1. BASE
2. EMITTER
3. COLLECTOR

SOLDERING FOOTPRINT*



*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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